OHIO BRASS MANAGEMENT REPORT

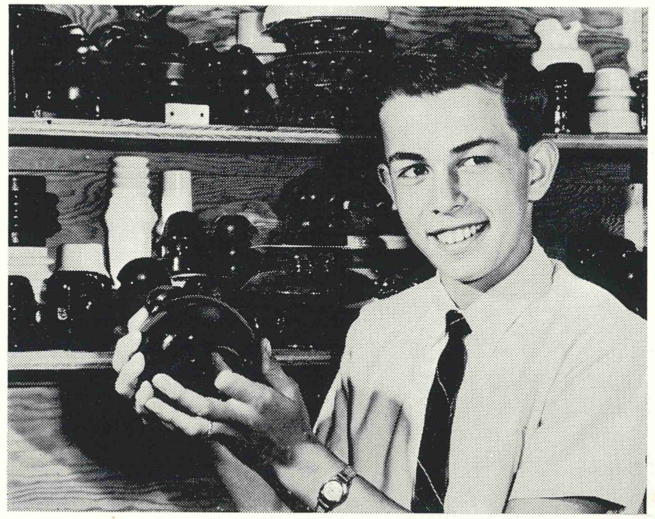
What Beatles? This Teen-Ager has eyes for insulators only

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY

"Today in the mail, I received your Ohio Brass Company catalog. I think it is very interesting. I understand the terms used in the catalog. I marvel over the 50,000-pound suspension insulator that you manufacture. The highest pound-rated suspension insulator that I have ever heard of was a 40,000-pound unit."

SO READS THE FIRST PARAGRAPH of a letter written on May 7, 1965, by a new holder of an Ohio Brass catalog. The comments would not be considered unusual except they came from a 12-year-old boy just finishing the eighth grade at Brockton, Mass. Also revealed in the correspondence from Joseph Maurath were details about the 60 insulators—collected over a three-year period—that he kept on "three large shelfs" in his bedroom. To keep O-B well represented, one of our product managers sent him three rare distribution insulators to add to his collection. The product manager promptly became a pen pal for Joseph. We learned that our friend in Brockton not only collected insulators, he made them out of plaster in designs he had developed himself. He sent us samples.

AFTER A FEW BROAD HINTS from Joseph, our product manager sent him a sample of the 50,000-pound insulator that he had coveted from the beginning. In May, 1966, Joseph, now 13, prepared a knowledgeable report on the history of the insulator industry. A second installment in June covered manufacture of insulators. With it came another revelation: Joseph was planning to visit us! He also wrote:



"I AM ENCLOSING A PHOTOGRAPH from a recent utility magazine of your company's president, Roger Black, holding an old prototype suspension unit. That's certainly quite an insulator. Tell Mr. Black I admire this insulator. I also see that your company is a real pioneer in the insulator industry." The visit did materialize in July. Joseph proved to be even more knowledgeable and personable than we had expected as he toured the factory and High Voltage Laboratory. His follow-up letter said:

"I NOW KNOW what the insulator industry is like, and my hopes are to continue my interest in power line insulators, learn more from them as well as about them and to take a great part in the business as probably an engineer." Maybe the time that our product manager and others spent with Joseph should have been used on more urgent tasks. But I wonder.

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OHIO BRASS COMPANY • MANSFIELD, OHIO
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OHIO BRASS

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Holiday Greetings

DECEMBER 1966

HI-TENSION NEWS

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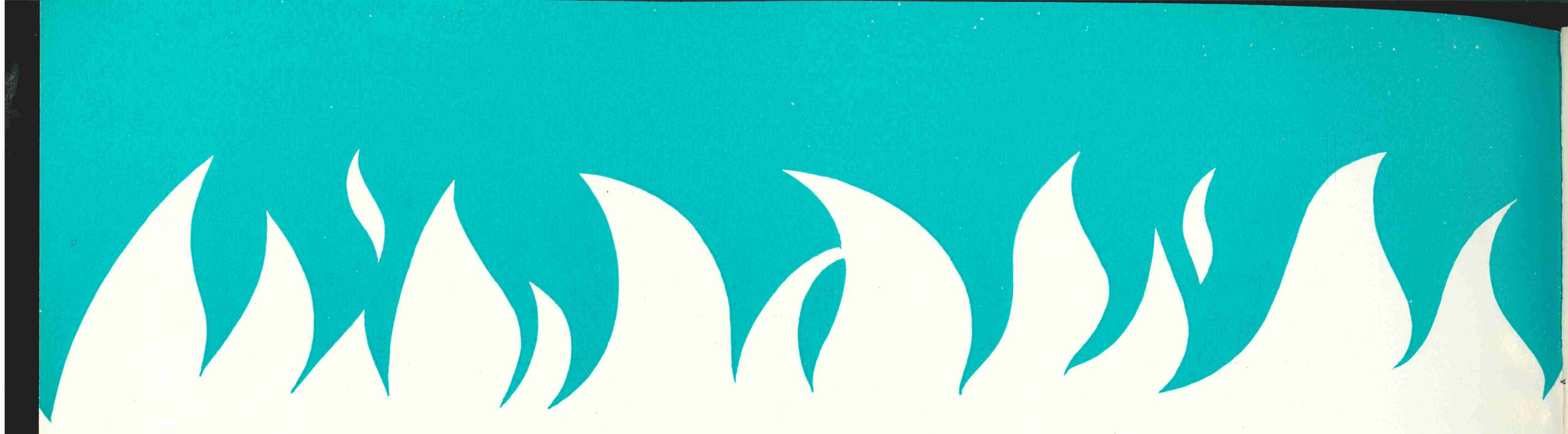

Pole fires follow a logical sequence

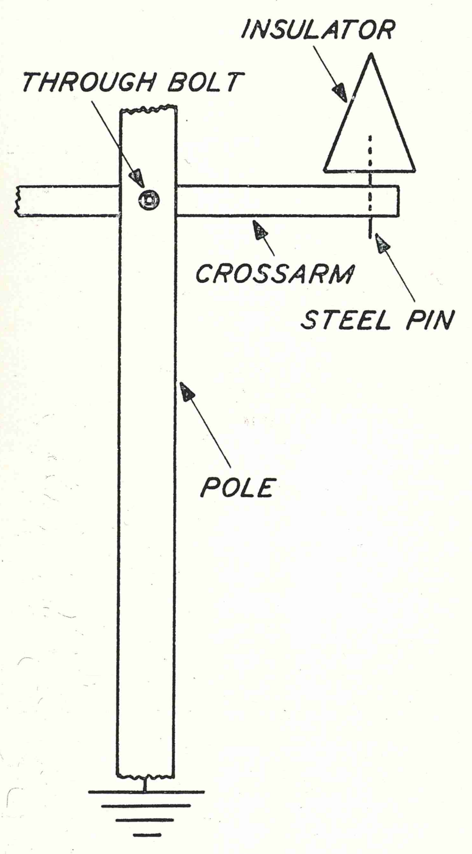

Figure 1 — Elements of a pole structure involved in the electrical leakage circuit sometimes resulting in a pole fire.

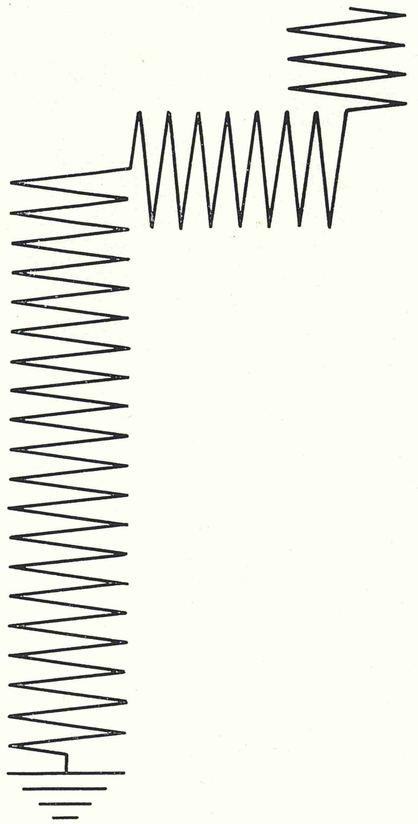

Figure 2 — Schematic electrical diagram of pole structure showing uniform high resistance of components when dry.

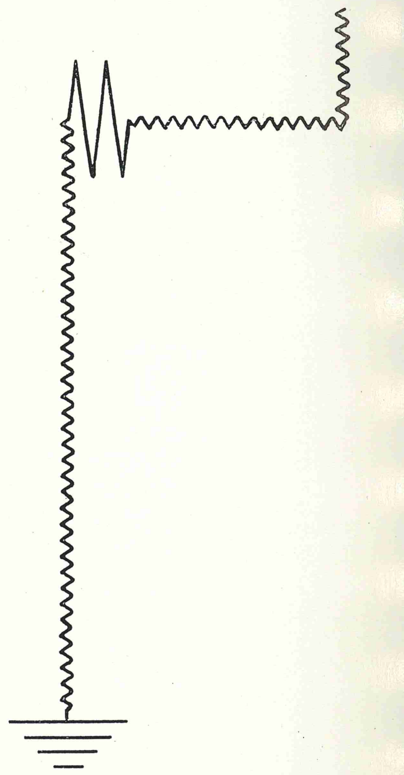

Figure 3 — Resistance diagram showing change in resistance when wet, with small high resistance "dry shadow" remaining.

Simple remedies offer a high order of prevention at little cost in material or labor

Burning of wood structures by leakage currents is an erratic occurrence . . . some distribution systems have seldom, if ever, had a pole fire . . . in another case we heard of, seven fires were in progress simultaneously in just one area of a city. Distribution departments that have rarely experienced fires can suddenly be confronted with a rash of this trouble. This is understandable since pole fires are closely related to contamination which is often unpredictable.

An understanding of the mechanism of pole fires may permit well-timed preventive measures. It can also offer an intelligent plan of attack if a system should become fire prone.

Several years ago the O-B High Voltage Laboratory embarked on an extended research project directed at a study of pole fires and the conditions that produce them. We will first briefly outline the laboratory approach to the problem.

It has long been recognized that leakage currents over contaminated insulators are intermittent in nature, having some of the characteristics of surge currents. These surges contain three variables: magnitude, time of duration, and frequency of occurrence. Many preliminary control tests were run with these factors varied in order to evaluate their relative effects.

Subsequently it was found that a continuously flowing current accomplished identical results in less time, permitting the accumulation of much more laboratory data within a practical period. A value of 10 milliamperes was found to duplicate field conditions accurately.

In order to cause the leakage current to be controlled principally by a circuit element other than the wood resistance, thus simulating the presence of a contaminated insulator with a constant leakage resistance, an impedance was inserted in series between the test transformer and the wood specimen. The wood specimen was then shorted out and the test transformer adjusted to 10 milliamperes through the impedance. When the short was removed from the specimen, and the wood was dry, its resistance was exceedingly high, limiting the current through the series circuit to less than one-half milliampere. On the other hand, if one surface of the wood was wetted, the leakage current would rise immediately to approximately 10 milliamperes, indicative of the wide range of resistance change due to the wetting effect.

Further investigations of changes in resistance showed that a piece of wood having 10 per cent moisture content would encounter a reduction in surface resistance in the order of 1,200 or 1,400 to 1, when that surface is wetted.

As a prelude to the start of tests, many samples of pole burning from the field were brought into the laboratory. These became standards of observation to be sure experimental results would realistically reproduce field experience.

Next step in laboratory preparation was the duplication of weather conditions conducive to pole fires. These, as established by innumerable observations, consisted of gentle precipitation . . . light rain, mist, or snow . . . driven by a moderate wind of steady direction. For this purpose the laboratory used a pressure paint spray loaded with water and set at low volume. For a directed wind, an electric fan was employed.

With realistic simulated current flow, and control over precipitation and air movement, any pole fire could be duplicated in the laboratory under highly predictable conditions. The laboratory result could not be distinguished from a similar case encountered in the field.

With a dependable technique established, the study of pole fires then proceeded.

A distribution structure consists of a series circuit comprising an insulator, a steel pin, a crossarm, and a pole; the arm and pole being connected by a through bolt, as shown in Figure 1. Electrically, when dry, all elements are in a state of high resistance, as in Figure 2. Now assume wind-directed light precipitation, coming over the left shoulder of the reader. We then get a condition as illustrated in Figure 3. Here, the wetted and contaminated insulator, the steel pin, and wetted crossarm and pole all drop to a low surface resistance value . . . except for one small area, namely, the section of crossarm protected by the pole from the impingement of rain. This we call the "dry shadow" of the pole. A high, concentrated resistance condition exists across the small dry area of the crossarm and through the gain in the pole to the through bolt. The exposed end of the bolt is in contact with the wet, low resistance pole surface.

If the specified atmospheric conditions continue for an appreciable time, and a leakage current in the order of 10 milliamperes is imposed on the small dry area, the surface resistance will break down and a charred path will develop, usually within the protected gain section. As this becomes intensified by increased heat and close confinement we have the start of a typical "pocket fire." Ultimately this can lead to open flame and destruction of the pole. (See Figures 4 to 9).

Certain specific weather conditions are a part of the process. First, a prolonged dry period in which the wood becomes excessively dried, perhaps down to a 10-per-cent moisture content. Second, light precipitation such as a heavy mist or a fine rain. Snow has a similar action. Third, a moderate wind of

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fairly steady velocity and direction. The foregoing atmospheric conditions do not promote uniform wetting and create a sharply defined "dry shadow" area on some part of the crossarm adjacent to the gain in the pole.

Another variety of pole fire is "tree burning" on the crossarm. While this usually fails to reach a condition of open flame, we received samples of burned-off arms from the field and could produce a similar gross situation experimentally.

"Tree burning" consists of a series of lacy carbonized paths on surfaces of the wood. Traces of this are often noted on arms that are still mechanically intact, although their presence predicts the possibility of ultimate trouble if ignored. (See Figures 10 to 14.)

Basically, the cause of this burning is related to that for "pocket fires," namely, non-uniform wetting of the arm, but in this case the condition may be accentuated by the flow of leakage currents. At the attachment points for hardware, a concentration of leakage current naturally occurs at the edge of metal parts where they contact the conductive surface of the arm. When mild precipitation is sufficient only to moisten the arm, points of concentrated leakage can become dried by heat, and charred paths will develop across these small zones. Grain patterns in the wood, having a higher sap content, are more electrically conductive than the surrounding fibrous material. Leakage follows these grain patterns as they become progressively dried by heat and causes a carbonization action. In most cases, a change in weather results in extinguishment of the burning before it reaches a critical point. An increase in rain drowns the fire, or cessation of the rain permits sufficient over-all drying of the arm to establish its normal high resistance, where leakage currents cannot produce the necessary magnitude to maintain burning.

It must be recognized, however, that a partially carbonized arm is more prone to successive burning than an arm free from the condition, since the paths that are present are already conductive. Studies of severe "tree burns" have shown quite clearly that the condition was one of successive attacks, rather than a single occurrence.

Naturally the question arises, what can be done to prevent pole fires? If possible, insulators should

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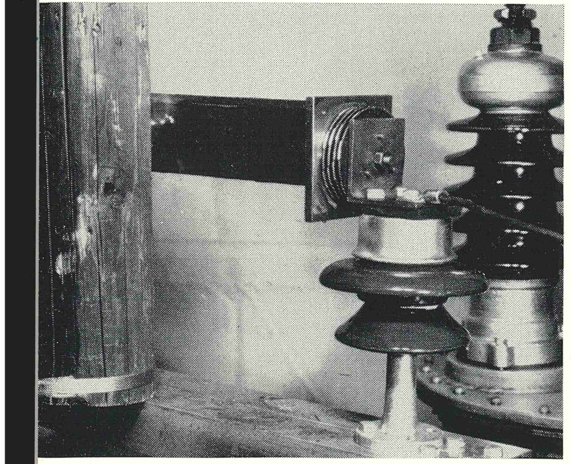

Figure 4 — Start of a "pocket fire" in the gain area between pole and crossarm. The high-resistance "dry shadow" of the arm has broken down electrically and charring has started to spread.

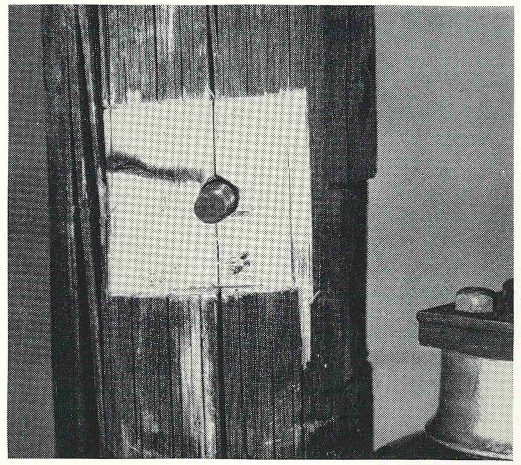

Figure 5 — Crossarm was removed after the start of charring to show the burned path being formed across the gain to the through bolt. This is a typical beginning of the destructive "pocket fire."

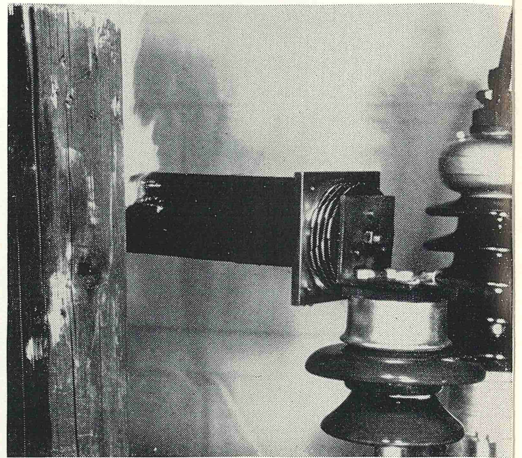

Figure 6 — Pole and arm were reassembled and the test was continued. In approximately 10 minutes open flame had broken out as a result of increased heat and confinement in the gain area.

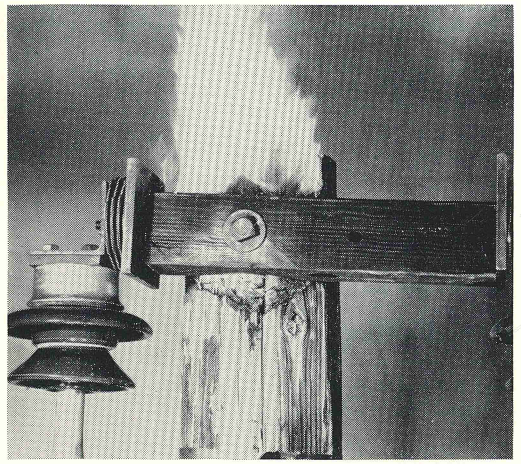

Figure 7 — A few minutes later, a full-fledged pole fire was in progress. At this point, if allowed to continue, the pole would have been destroyed, as is the common experience in service.

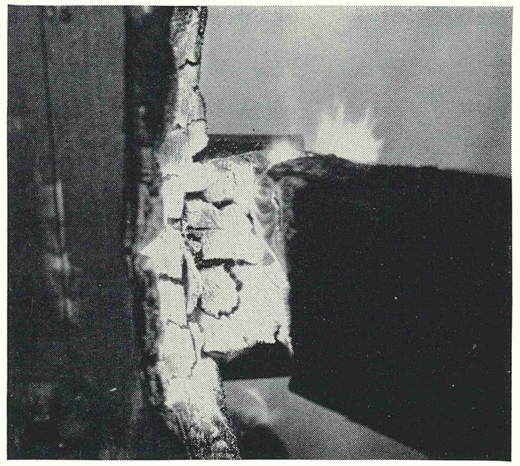

Figure 8 — With the flow of current stopped, and a little water applied to subdue the flame, the gain area was photographed to show the glowing hot coals on adjacent surfaces of pole and arm.

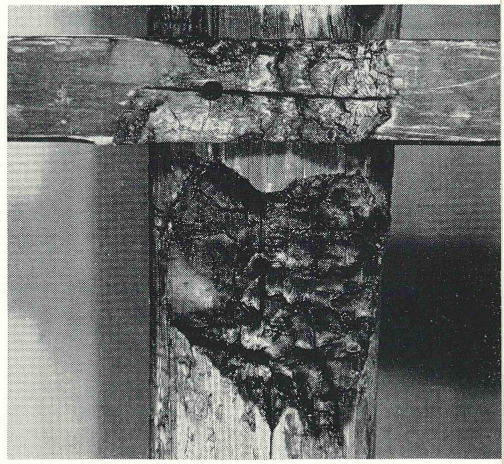

Figure 9 — When the fire was extinguished, the arm was rotated toward the camera to show extent of damage sustained in a total time of approximately 20 minutes. Complete destruction was imminent.

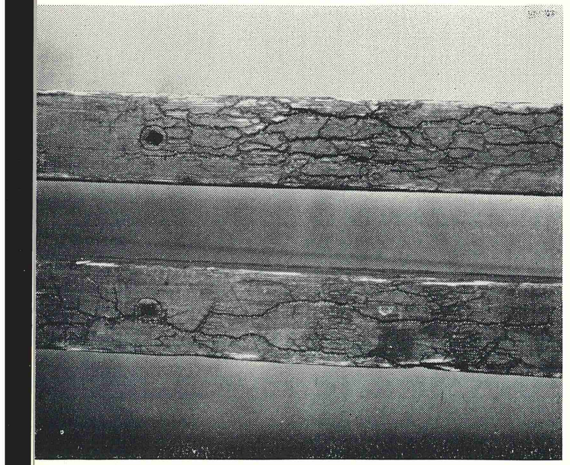

Figure 10 — Characteristic "tree burn" on crossarms brought into the laboratory from the field. Specimens such as this were used as standards of observation to check validity of experimental results.

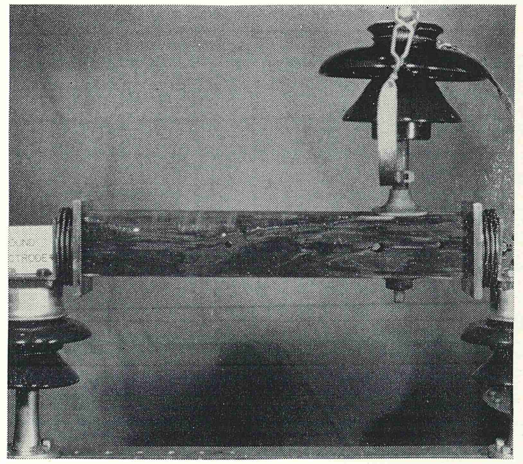

Figure 11 — Start of a laboratory "tree burn." Because of the time it takes the wet crossarm to break down and start char paths, the contaminated insulator was jumpered in order to apply full voltage.

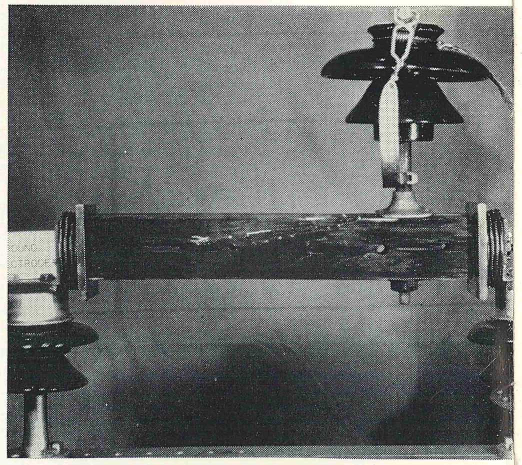

Figure 12 — Char paths, following the grain structure of the wood, are becoming well developed on the face of the arm. Note concentration of burning at the base of the steel pin, which is to be expected.

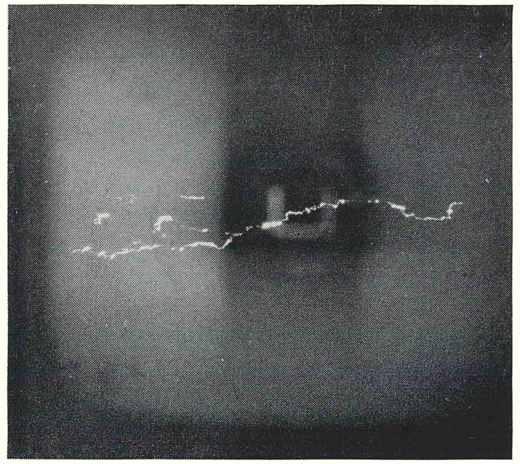

Figure 13 — Char path has now become a glowing carbonized "thread" of irregular shape, following the sap wood in the grain of the crossarm. This accounts for the typical lacy pattern of burns.

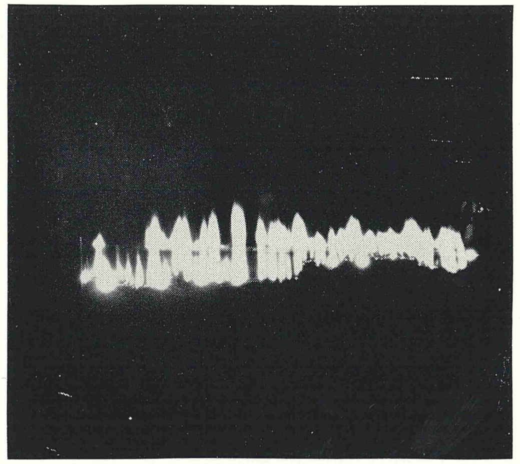

Figure 14 — If not arrested by a change in weather conditions, a "three burn" can eventually break out into full fire. While somewhat uncommon, we have received reports of several totally destroyed arms.

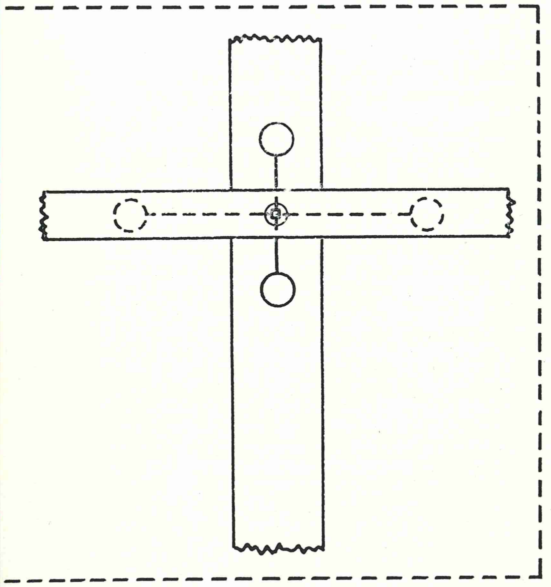

Figure 15 — This simple burn-preventive measure is made with light copper wire (14 to 18 gauge). Loops and runs of wire must be firmly stapled to the wood, and good connection made with the through bolt.

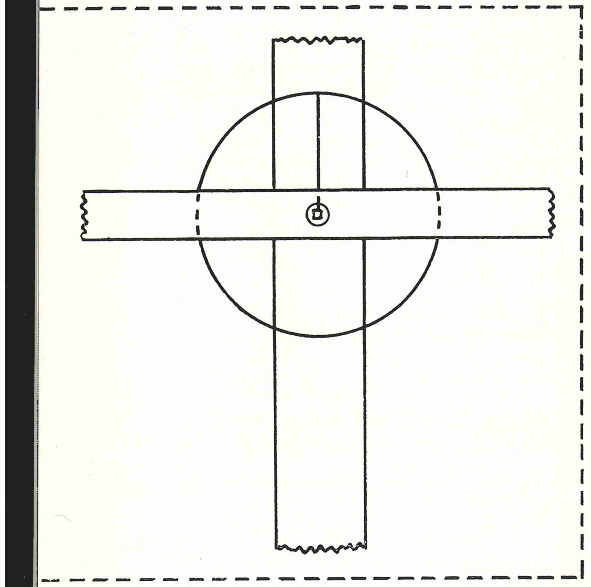

Figure 16 — Another anti-burn device made with heavy copper wire formed into a hoop, with one end bought to the center for connection to the through bolt. Firm stapling to the wood is necessary.

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be kept sufficiently clean so they will not conduct the necessary surface leakage current. This is not always a practical answer. Under certain conditions, insulators can become contaminated in a short time and without the knowledge of people responsible for maintenance. An insulator that will pass only 10 milliamperes of leakage current, when wet, will usually not call attention to itself.

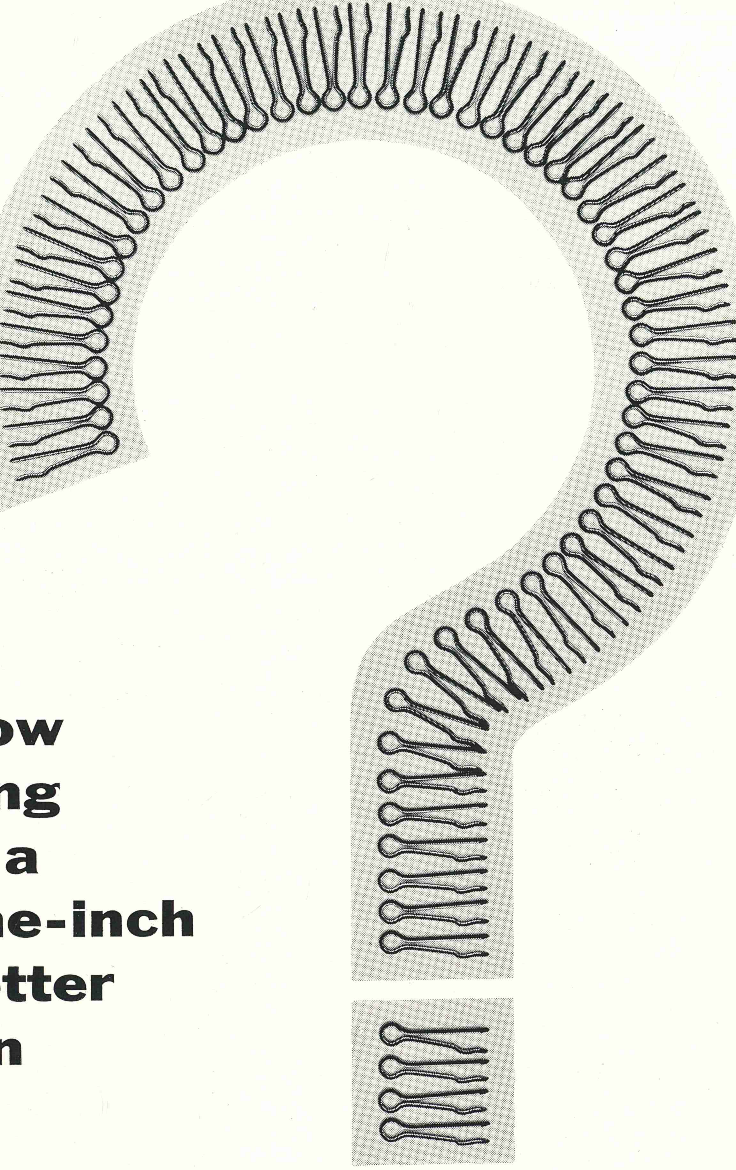
The most practical remedy for the trouble consists of shunting-out the potential "dry shadow" areas with a conductor. One very satisfactory measure consists of stapling a piece of light copper wire (14 to 18 gauge) along the face of the crossarm on the gain side, and a second piece for a short distance on the pole above and below the gain. (Figure 15). These wires should be well connected to the through bolt and tightly stapled to the wood at many points to assure positive collection of any leakage current. The shunts must be sufficiently long to contact the constantly wet, low resistance surfaces and bridge the possible high resistance "dry shadows." To prevent "tree burning" they must be connected to the insulator pin and to any metal crossarm braces. This can be done with a minimum cost of material and labor, and without service interruption.

Another device (Figure 16) has been found quite effective against "pocket fires." A hoop 1½ to 2 feet in diameter is made from fairly heavy copper wire (about 6 or 8 gauge). One end is left long enough to bring to the center in order to make a connection with the through bolt. This loop is then stapled to the arm and pole on the gain side, encircling the intersection. Again, care must be taken to get a good connection to the pole surfaces and through bolt. While requiring several feet of heavy copper wire, these hoops can be pre-fabricated in the shop, and their quick installation may save enough time to pay for the difference in cost of material.

Many other shunting measures, such as pieces of copper screen wire, braided copper tapes and sheets of metal have been suggested as shunting devices. It makes very little difference what is used as long as it will conduct leakage currents to the through bolt and across the high resistance "dry shadow" area that commonly exists near the junction of pole and crossarm. There is only one precaution to follow in using any device chosen . . . be sure the shunt has a good, permanent electrical connection with wood surfaces and through bolt.

The question has been asked regarding the effectiveness of metal crossarm braces in bridging the "dry shadow" areas. Too many assumptions must be made in this case. All bolts and screws must be tight and have a low resistance contact with the brace in order to establish an effective shunt path. Shrinkage of the wood and surface corrosion of metals would make it close to impossible to maintain tight, conductive connections in such a circuit. A metal brace is not dependable for this service.

POST SCRIPT — It may interest the reader to recount an amusing experience that occurred in the course of our laboratory investigation of pole burning. These experiments were published several years ago in an IEEE Paper authored by Paul M. Ross, at that time Superintendent of the O-B High Voltage Laboratory, and presently Manager of the Power Utilities Department. One day, during the period of tests, Mr. Ross and the writer of this article left the laboratory for lunch. It was a gloomy day with a light drizzle and a gentle wind. Jokingly, we remarked, "What a swell day for a pole fire!" Returning from lunch, we found the plant shut down . . . the pole adjacent to the factory substation had the entire top burned out of it. This doesn't necessarily prove we were clairvoyant. It simply points-up the fact that pole fires can have a definite pattern.



How long is a one-inch cotter pin

A while ago one of our users of suspension clamps lost or broke a few of the "humpback" cotter pins and wrote in for some replacements. He measured the length of the pin and specified this on his order. The pins he got were ¼-inch too long. We explained that the measurement should be taken ignoring the looped portion.

Having now become an experienced cotter pin measurer, the same man later wrote in for some extra pins for socket fittings, using his newly acquired knowledge of measurement. These pins were ¼-inch too short. He should have taken an over-all measurement this time.

A third time he needed some pins. On this occasion he wrote a letter with a pin taped to the corner, saying "Send me a hundred of these blankety-blank things!"

He got the pins, and our district manager was instructed to take him to a local bar and express our sympathy.

Nomenclature of cotter pin measurement is a manufacturer's custom. We don't control it. In case you ever want any spares, let us explain how they are measured. (And by the way, do you happen to know how they measure the length of round head, flat head, and oval head wood screws? Inconsistency isn't the sole property of the cotter pin business.)

For ball-socket type suspension insulators, and for socket type fittings that engage these insulators, a flared shape of cotter pin is used. See Figure 1. Length of this pin is measured over-all, as indicated by "L" on the drawing.

For other fittings, where the cotter pin holds the rivet in a clevis connection, in either hardware or clevis type insulators, the humpback pin is used. See Figure 2. Length of the pin ignores the looped portion. Dimension "A" is the diameter of the rivet. It often helps to specify this. Dimension "B" is the length measurement. Dimension "C" for size of stock in the pin is taken with the pin fully closed, disregarding any slight opening at the end.

Cotter pins as shown in Figures 1 and 2 may be obtained in either brass or stainless steel. The latter metal is used in combination with aluminum. These pins are listed on page 33 of the O-B Hardware Catalog Number 44.

We hope this long dissertation on a short subject may save you trouble some time. It may save us some time too.

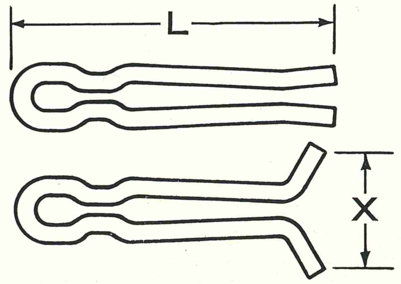


Figure 1

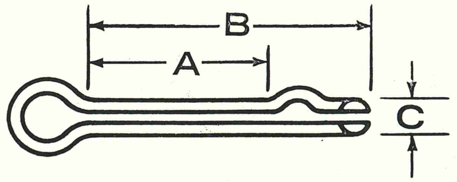
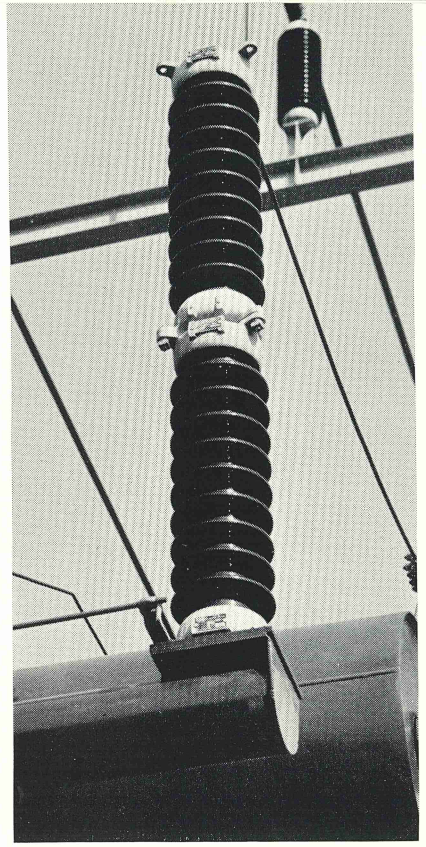


Figure 2



The new, reduced IR discharge voltages of Ohio Brass GP Dynagap arresters provide highest protective margins available in intermediate class.

Important new reductions in discharge voltages re-emphasize advantages of GP intermediate arresters

Improved valve block characteristics now provide greater protective margins and better durability

O-B's Thorex Dynagap GP lightning arresters stand out in any comparison of intermediate arresters, since they are the only design incorporating the current-limiting series gap for the interruption of power follow current. Because of this exclusive feature, GP arresters are the only intermediate arresters in a position to benefit from the continuing advances made in expanding the function of the current-limiting gap principle to meet the increasing requirements of modern station class arrester applications.

The important reductions in IR discharge voltages now announced for GP intermediate arresters are directly due to refinements achieved in valve blocks compounded specifically to work in conjunction with the powerful current-limiting gap. The dominant action of the Dynagap element in controlling power follow current interruption relieves valve blocks of a major portion of their former responsibility in limiting power follow current and opens new possibilities for designing blocks with lower inherent impedance and greater durability.

The extent to which representative discharge voltages have been reduced as the result of introducing lower impedance blocks in GP intermediate arresters is indicated in the chart shown in Figure 1. The new values are compared in the graph with values now cataloged by other manufacturers of intermediate arresters.

The chart in Figure 2 traces the historical progress accomplished in reducing the IR discharge voltages of intermediate arresters. This chart was made by comparing the published values for the IR discharge voltages of 60-kv intermediate arresters when subjected to the standard 10-ka current discharge. The obvious role which O-B has taken in setting the pace for discharge voltage reductions has meant an industry-wide improvement in the protective margins provided by intermediate arresters.

While not shown on the chart, the reductions in discharge voltages have been so extensive that their values actually approach those of some station grade arresters. The new GP intermediate arresters provide protective characteristics which far exceed those of any present or older intermediate arresters. In fact, up to less than four years ago, no arrester — even station type — equaled today's Dynagap GP.

The correspondingly greater protective margins obtained due to lower discharge voltages of the GP arresters are particularly important in the re-evaluation of older protective equipment. No better plan has been proposed for extending the useful life of expensive equipment with insulation possibly deteriorated due to overloads or long service than a compensating increase in protective margins.

The improved operating characteristics of GP Dynagap arresters are expanding their range of application. Best example of widespread new use for GP's is their installation in connection with feeders supplying underground cables, but field reports also indicate extensive growth in their use in the suburban and industrial substations which account for most of their installations. The combination of low original cost and high dependability found in the GP Dynagap's protective capabilities constitute an unsurpassed primary step in upgrading system reliability.

Figure 1—Chart of cataloged IR discharge voltages of intermediate arresters available in today's marketplace.

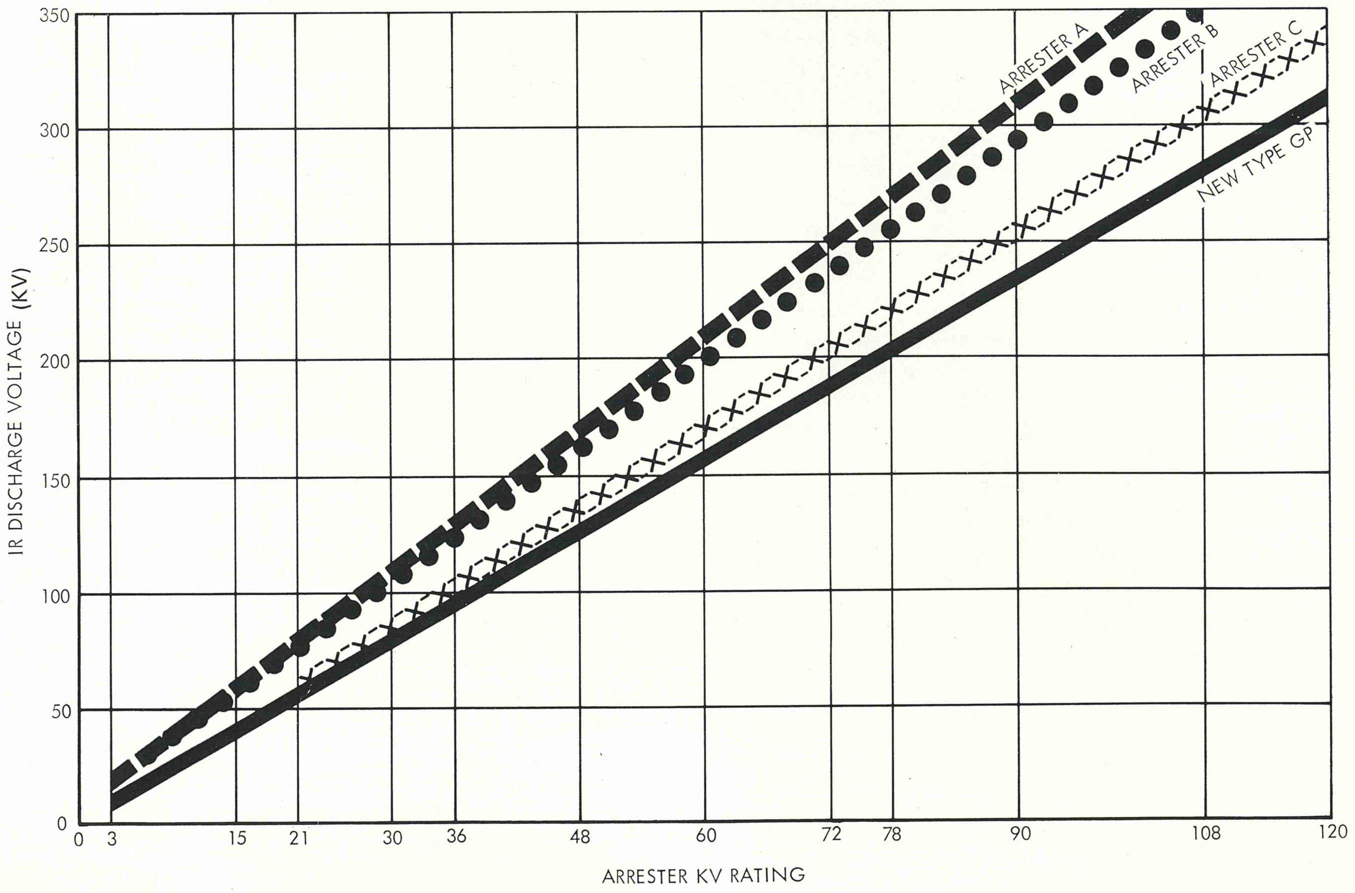
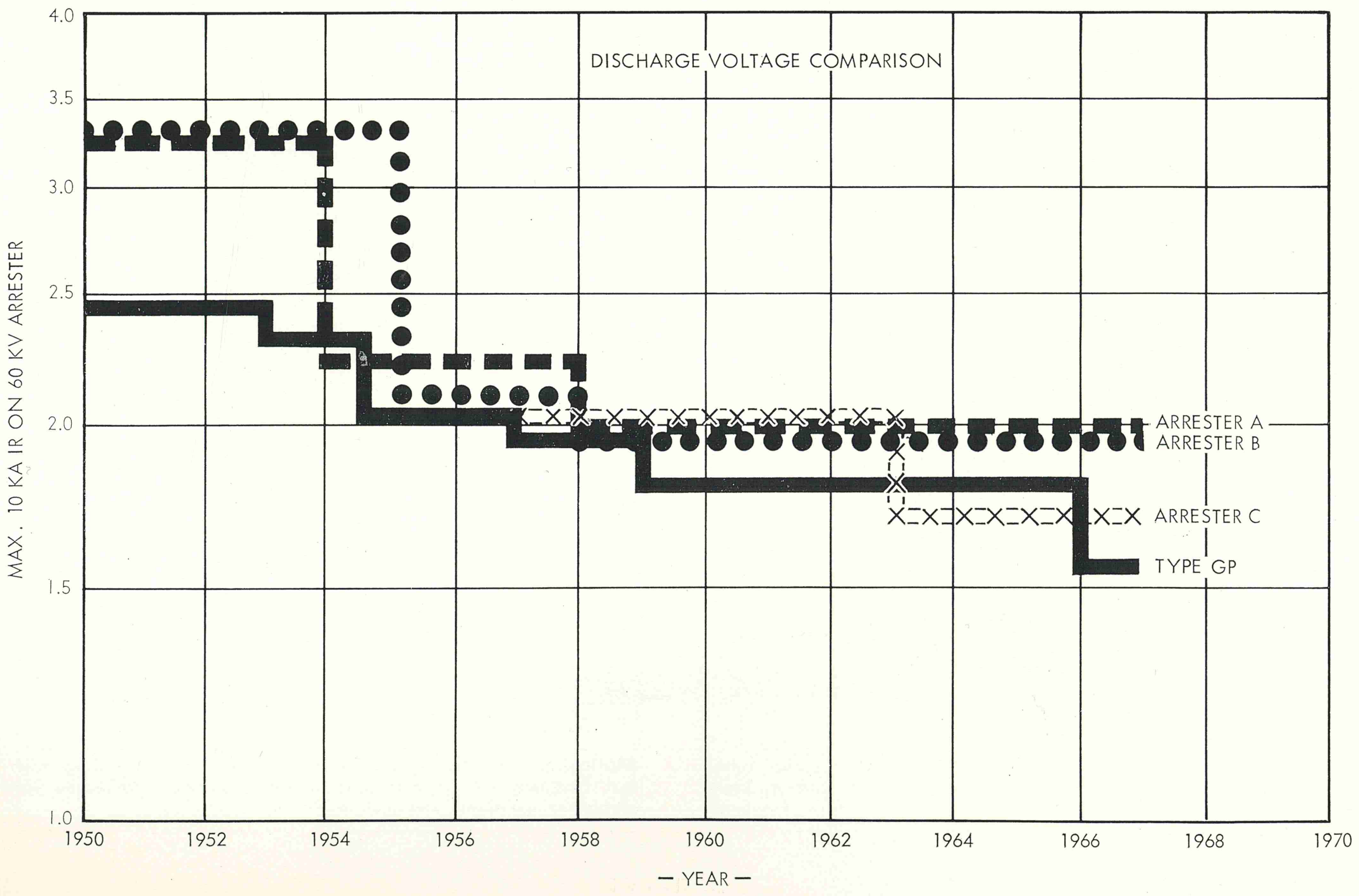


Fig. 2 — Historical comparison of IR discharge voltages of intermediate class arresters.



Malleable iron hardware offers many desirable properties

Malleable iron has attributes which particularly recommend it for service on all power conductors, including those for distribution voltages. While nonferrous metals have attained popularity in recent years, they cannot detract from some of the basic merits of malleable iron.

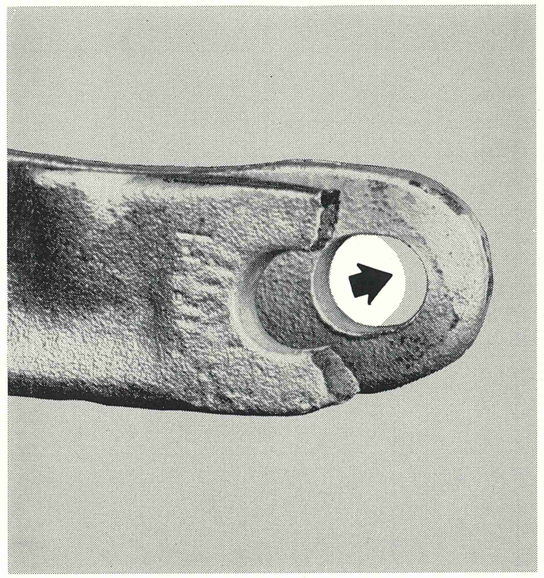
Malleable iron combines excellent strength characteristics with high ductility. On test as well as in field service, it withstands deformation, stretching, and abrupt bending without fracture. In emergencies, conductor clamps will retain their grip and provide support under extremes of abnormal loading. Malleable is ideally suited to the manufacture of hardware fittings.

In its molten state, when it is cast, this metal has the valuable property of fluidity. Certain other metals never become more fluid than a heavy syrup; they do not follow the intricate shapes of a complex mold, imposing a severe restriction on product design. Conversely, malleable iron is very "thin" in its molten state and imposes very few limitations on shape, thickness, or design detail. It will take the shape of almost any mold with a high degree of fidelity. Development engineers can conceive the most desirable form for a piece and be assured that malleable iron will provide its accurate interpretation.

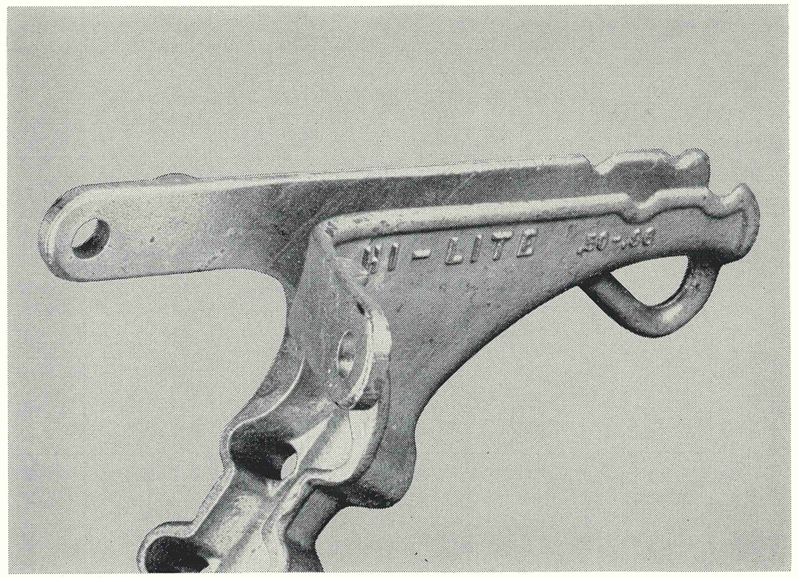
Resistance to corrosion is one of malleable's most important properties. This is due to the formation of a tenacious oxide coating when the piece is exposed to the elements. In this manner, rusting *does* occur. But it is not progressive, and the metal is self-protecting to a considerable degree. Other ferrous metals exposed to weather will rust, flake off, and rust again, until the product may lose sufficient material in critical areas to affect its mechanical strength.

All O-B malleable iron products are protected by a thick, hot-dip galvanized coating. In addition to cleanliness and good appearance, the H.D.G. coating provides a lasting primary preservative for the base metal. In exceptional cases of prolonged exposure to chemical contaminants, where the galvanized coating is attacked, the corrosion resistance of malleable iron will extend the life of the product almost indefinitely.

Malleable iron is standard or optional in such O-B equipment as: Universal clamps, Strateline clamps, Hi-Lite strain clamps, Clamptops, suspension insulator caps, suspension clamps, hardware fittings, and a variety of miscellaneous hardware for transmission and distribution line applications.



Under tremendous stress, malleable iron strain clamp takes considerable deformation and stretching prior to failure. Note the extent of elongation in the rivet hole before fracture.

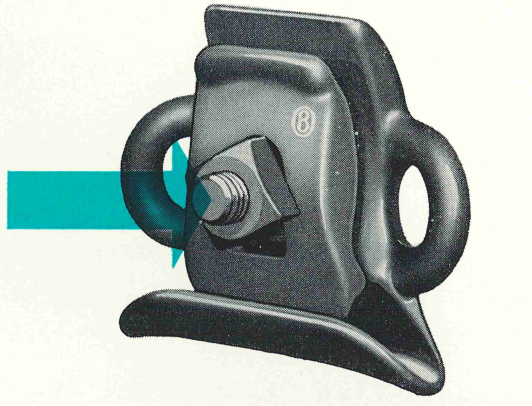


Malleable iron strain clamps withstand abrupt bending without fracture — on test and in field service. Malleable iron combines excellent strength with high ductility.

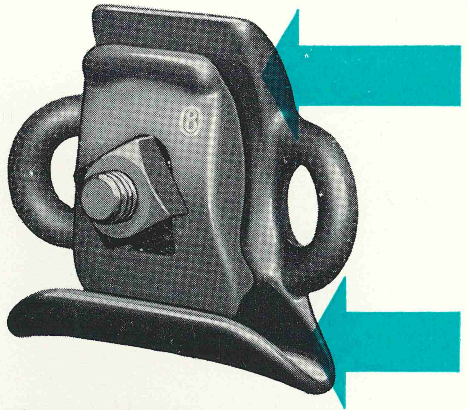
It's a simple job . . . but you still have to do it right

Trouble has been engineered out of O-B Neutral Clamps

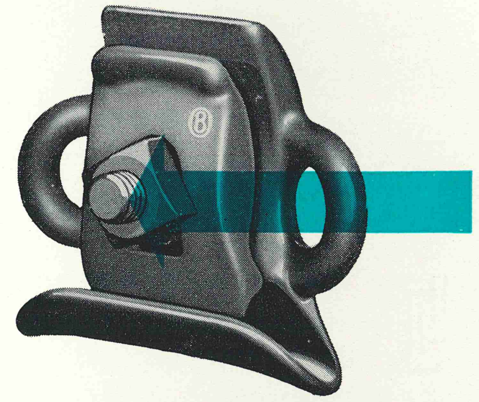
When it comes to small pieces of pole hardware, the two biggest elements of cost are: (1) What does it cost to install them? (2) What does it cost to come back if they cause trouble? On this basis the O-B Neutral Clamp is an investment, not an expense. A lot of good engineering talent has gone into this simple device. Look it over, one part at a time, and you'll see what we mean. Then start putting it on your distribution poles.



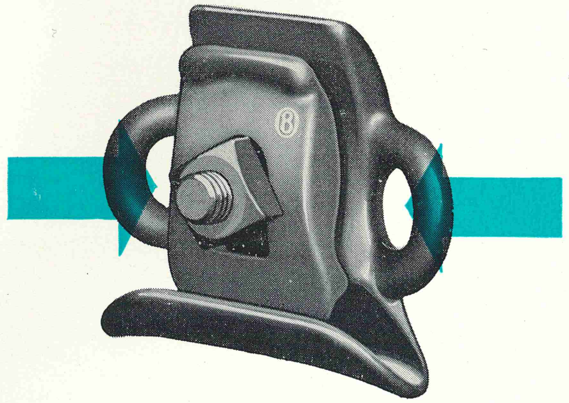
To meet construction standards, or to suit your preference, through-bolts may be supplied in either ½-inch or ⅝-inch size.



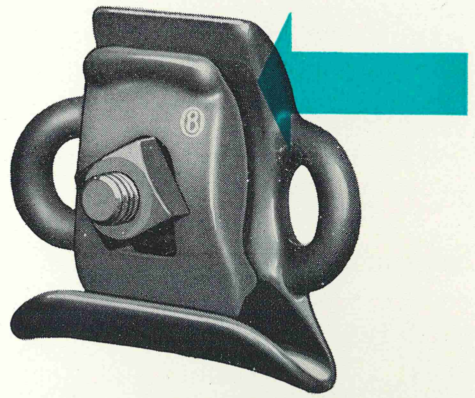
Lower seat has a conductor range of .225/.625-inch. Upper seat fits all common sizes of grounds or neutral secondaries. Any combination of sizes can be used. Drawing down the clamping nut establishes a tight grip on both wires.



Through-bolt is threaded into the clamp body, so that positive clamping pressure is exerted between metal parts. In this way, pole shrinkage has no effect on permanent clamping action.



Two eyes, cast integrally with the body, offer a convenient anchorage for deadends. These eyes are exceptionally strong to take heavy strains if necessary.



Body is strong malleable iron with a protective coat of hot-dip galvanizing. This clamp will probably live longer than the man who puts it up.

OHIO BRASS MANAGEMENT REPORT

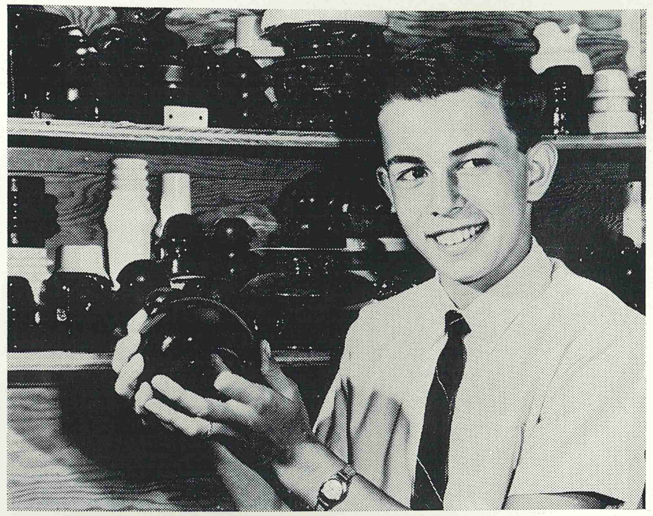
What Beatles? This Teen-Ager has eyes for insulators only

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY

"Today in the mail, I received your Ohio Brass Company catalog. I think it is very interesting. I understand the terms used in the catalog. I marvel over the 50,000-pound suspension insulator that you manufacture. The highest pound-rated suspension insulator that I have ever heard of was a 40,000-pound unit."

SO READS THE FIRST PARAGRAPH of a letter written on May 7, 1965, by a new holder of an Ohio Brass catalog. The comments would not be considered unusual except they came from a 12-year-old boy just finishing the eighth grade at Brockton, Mass. Also revealed in the correspondence from Joseph Maurath were details about the 60 insulators—collected over a three-year period—that he kept on "three large shelfs" in his bedroom. To keep O-B well represented, one of our product managers sent him three rare distribution insulators to add to his collection. The product manager promptly became a pen pal for Joseph. We learned that our friend in Brockton not only collected insulators, he made them out of plaster in designs he had developed himself. He sent us samples.

AFTER A FEW BROAD HINTS from Joseph, our product manager sent him a sample of the 50,000-pound insulator that he had coveted from the beginning. In May, 1966, Joseph, now 13, prepared a knowledgeable report on the history of the insulator industry. A second installment in June covered manufacture of insulators. With it came another revelation: Joseph was planning to visit us! He also wrote:



"I AM ENCLOSING A PHOTOGRAPH from a recent utility magazine of your company's president, Roger Black, holding an old prototype suspension unit. That's certainly quite an insulator. Tell Mr. Black I admire this insulator. I also see that your company is a real pioneer in the insulator industry." The visit did materialize in July. Joseph proved to be even more knowledgeable and personable than we had expected as he toured the factory and High Voltage Laboratory. His follow-up letter said:

"I NOW KNOW what the insulator industry is like, and my hopes are to continue my interest in power line insulators, learn more from them as well as about them and to take a great part in the business as probably an engineer." Maybe the time that our product manager and others spent with Joseph should have been used on more urgent tasks. But I wonder.

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OHIO BRASS COMPANY • MANSFIELD, OHIO
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OHIO BRASS

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Holiday Greetings

DECEMBER 1966

HI-TENSION NEWS

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